RELEASE 1.0

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THE FUTURE OF THE LOCAL LOOP
by Jerry Michalski

Zoe is torn. Should she buy a keyboard remote-control and set-top radio receiver from Interactive Networks to second-guess quarterbacks, a Compaq Presario and a GEnie account to have real-time dogfights with other users, or a multiplayer from 3DO to explore dungeons and slay bug-eyed monsters? Should she wait for her bank to offer her a deal on a screen phone for home banking, or for a set-top box from Scientific Atlanta or Silicon Graphics so she can channel-surf between the Vegetarian Channel and the colorized reruns of classic black-and-white films? Or should she just keep her tv and cordless phone, buy some AA batteries for her Newton and call it a day?

If you think Zoe's torn, imagine the communication-company staffers perched in their strategic-planning chairs. Each of these device/application combinations implies different infrastructure requirements. For example, Interactive Networks is highly asymmetric: It broadcasts a data signal over radio channels, parallel to broadcast or cable tv; subscribers upload their results by phone. Channel-surfing is also asymmetric, but more sensitive to delay. Real-time games require even swifter response, but not much bandwidth in either direction as long as they do not use video.

Long-haul networks seem to be converging to fiber and microwave, but what about the short haul? It's a mess, but a look at the economics makes one thing clear: There isn't enough disposable income around to support more than two or three suppliers of local broadband connections. (Note that telephone, paging, cable tv and cellular networks already reach the majority of US residents and businesses.) First-move advantages might outweigh the negatives of poorly placed technology bets. So companies are jumping in, with nervous bravado.

The many cable-tv and telephone convergence pilot projects across the country are million-dollar call options on those billion-dollar bets. But the trial results haven't been cheery, and the options continue to multiply.

Should we have dumb devices and a smart network, or distributed switching and a client-server architecture? Should the transport be all digital or hybrid? How far downstream can we carry fiber? How much, if any, upstream capacity should we offer? What protocols should we use? How much control should we ⟹

PC FORUM PREVIEW, PAGE 22

INSIDE

THE LOCAL LOOP 1
Desires and dynamics.
CLEVER SOLUTIONS 12
Metricom.
Community dialtone.
CircuitPath.
SONeTech.
RESOURCES & CALENDAR 19
Names, phones, books, dates.
PC FORUM PREVIEW 22
Interactivity is two-way!

retain? What does "open" mean now? Who should be allowed to compete; who should be restrained? And where's the aspirin?

One if by LAN, two if by UTP

Many of these questions affect the fundamental nature of current communication systems. They particularly affect the part we focus on here: the local loop.[1] Some people refer to it as the on- and off-ramps to the information superhighway; others think of it as the distribution system for information. Some may not use the superhighway at all. For such local users, it's the entire communication system.

In this issue we define "local loop" as any technology or medium used to get from a long-haul carrier's local point of presence to a subscriber's premises, or to connect the local premises to each other. The long haul may consist of tv signals from satellites, data packets over wide-area networks, conversations over fiber-optic trunks or any combination. The "premises" may be very small and mobile, such as a cellular phone or PDA on the road. Thus we cover not only the phone company's copper wire, but also fiber-optic cables, coaxial cable (coax), power lines and various flavors of wireless technology (see **Release 1.0**, 10-92 for a broad survey of wireless).

The US local telephone business is roughly $70 billion, about equal to US long-distance revenues. However, about a third of the local companies' revenue consists of access charges; their future is uncertain.

Cable tv companies may be upgrading their systems to higher broadcast capacity with some upstream capability, but as they mix and merge with phone companies and others, this will prove insufficient. Eventually, the phone system's so-called Intelligent Network, which now encompasses only traffic between end offices (not beyond, to customer premises or other prospective carriers), will evolve to a generalized, highly distributed intelligent network with many new players. Successful cable tv companies will become a part of it. The companies we profile in this issue exemplify the thinking that will transform the information infrastructure over the next decade.

Feast or famine; friend or foe?

There's no shortage of confusion, even on basic assumptions. Depending on whom you talk to, there's either a desperate scarcity of bandwidth for wireless services or plenty to go around; acquiring cable tv properties and media libraries are strokes of genius or acts of lunacy; ISDN is a decade late and a dollar short, or it's the standard that can save us all; local telephone companies are regulation-challenged friends or the devil incarnate; ATM is the transport wave of the future, or Ethernet is; the information superhighway will create incredible competitive advantage for the US, or it will suck all available investment funds into unprofitable businesses. There's truth to both sides of each pair of assertions.

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1 *"Local loop" is the term the telephone industry uses for the last leg of the connection from its central offices (COs) to subscribers' premises. It really is a loop of copper wire: Lifting the phone handset closes the loop, completing an electrical circuit, which carries the dialtone that is generated at the CO.*

Here are some assertions of our own:

- Building a local distribution network from scratch is prohibitively expensive unless the service provider doesn't need to buy real estate, deal with myriad local authorities for permissions and licenses, and dig trenches or hang cables (see Metricom, page 12). That makes the use of existing coax drops to households pretty appealing for broadband communications, and even for voice and data.

- Fiber is unlikely to make it all the way to most end-users soon, unless overzealous local-exchange carriers convince their regulators it's worth it. It's fine for new homes and business users who have to deal with images or huge data files. But the gear is expensive, and installing the fiber won't get cheaper (see above). Businesses can aggregate traffic, warranting fiber to their premises, but most homes already have copper and coax in place and will be hard-pressed to exceed that potential capacity. That leaves gaps to fill (see CircuitPath, page 15). Clever hybrid systems (e.g., analog and digital over coax) will do well. Meanwhile, wireless systems have significant advantages in rollout speed, cost and mobility, even though they don't have the bandwidth for 500 channels of digital nirvana in the near future.

- Interaction matters (check out our Forum preview, page 22). Low latency (quick response) is at least as important as high bandwidth. Common protocols and access rules matter at least as much as the physical media. And integration across media matters far more than the ability to stagger reruns of Terminator 2 every 15 minutes (unified messaging issues, **Release 1.0**, 12-92 and 1-93).

- The government should make costs and subsidies explicit; rethink and simplify jurisdictions, rules and restrictions; set minimum performance standards, so concepts such as basic service don't lose their meaning; and foster harmonization and coordination of protocols and addressing schemes. It should guarantee open access to the medium and protect privacy. Overall, it should level the playing field but keep its hands off the players.

- Monolithic entities, whether media producers, information providers, telephone companies or cable tv operators, are in danger of being commoditized or deconstructed. One viable defense is to become the host of choice for everyone else's activity. Despite all the thrashing about interactive video, the phone system may undergo the most profound changes (see Community Dialtone and SONeTech, page 14).

- Local electric utilities are a dark horse. They claim to justify installing *fiber* to each customer based on savings from turning down appliances at peak-load hours. Remember, NIMBY (not in my back yard) has made new power plants improbable; the true cost of a power plant is huge, once you factor in hearings, litigation, etc. Even if utilities install only coax, they will have a substantial effect on the local-loop market.

A new Bell(e) epoque?

Welcome to the post-post-Divestiture era. Next New Year's Day is the tenth anniversary of Divestiture -- the Baby Bells' tenth birthday. Court decisions and reregulation are dissolving the *de jure* monopoly that local telephone and cable tv companies have enjoyed. Alliances, mergers and acquisitions are reshaping the industry from vertically and horizontally separate (BellSouth can't supply tv in Atlanta; it can't offer wired phone service in Los Angeles -- but it could run a cellular system) to a patchwork quilt with a few vertically integrated distribution systems. Some companies will integrate from content creation and licensing all the way to delivery; others will stick to specific layers.

It's easy to view the AT&T/McCaw or Bell Atlantic/TCI deals as attempts to reestablish the Ma Bell hegemony, but this is too simplistic and ignores the fundamental changes afoot. If current trends continue, barring an economic collapse, every potential subscriber will have several telecom alternatives.

Some phone companies have decided to turn the turmoil to their advantage rather than fight it. Ameritech recently opened its local-loop business to competition, hoping to win rights to compete in other areas, particularly in long distance. Rochester Telephone, a major independent phone company, is dividing itself into wholesale and retail operations. Pactel has split its local-exchange business off completely, and recently announced a $16 billion fiber/coax investment. Local exchange carriers in New Jersey, Florida and other states have convinced their public utility commissions to allow them to deploy broadband networks.

Other phone companies are resisting a breakup, but the pressure is coming from all quarters, and will probably be overwhelming. If competitive pressure doesn't do it, the FCC likely will. (Noteworthy documents include US Senate Bill 1086, MFS's petition to the FCC for review of Universal Service, and the EFF's Open Platform initiative; Resources, page 19.)

Bypass, bypass everywhere

Much of the recent turmoil is due to incursions by competitive access providers (CAPs) such as MFS Communications (formerly Metropolitan Fiber Systems) and Teleport (which is owned jointly by TCI and Cox Enterprises). Their metropolitan-area fiber-optic networks offer large companies great deals on local communications. MFS's success in offering bypass to businesses in Chicago persuaded Ameritech it had to open its turf to competition. Perhaps more significantly, MFS has petitioned the FCC to reexamine the definition of universal service.

Although it's not their stated mission, cable tv companies want to be competitive access providers in residential markets. This is already happening in the UK, where Nynex and other US telcos have teamed with local partners to offer combined voice/cable tv service that competes with British Telecom. Hopefully these companies will learn which architectures work best.

Prodigy redux?

Naturally, nobody wants to be caught with the wrong infrastructure a few years from now, as Prodigy was because of faulty assumptions about human be-

havior. Despite staff protests, Prodigy management had its engineers build a system optimized for broadcasting information and processing transactions. Bulletin-board and messaging software were afterthoughts.

Top management was shocked when its subscribers insisted on connecting with each other, but by then Prodigy had an expensive (and not fully depreciated) network that didn't (and still doesn't) support real-time chatting. (Partly because of this problem, Prodigy is installing routed subnetworks, and is linking up with cable tv companies, as we described in **Release 1.0**, 7-93.)

Prodigy, Act I, is the nightmare scenario. Yet what are most of the major convergence players promoting? Pay-per-view, home shopping and movies-on-demand, with very limited upstream capabilities. Repeat performances, with new casts, are all too possible.

DESIRES AND DYNAMICS

There are some viable businesses in this potpourri, but how can vendors and carriers frame their local-loop strategies? What will cause individuals and businesses to part with more time or money, or at least to reallocate what they spend now? One way to get from behaviors to strategy is to ask the following three questions: what's the leap? how should we optimize the platform? and how do we get there?

What's the leap?

Peter Drucker wrote that in order for a new technology to thrive, it must offer an order-of-magnitude improvement in cost or value relative to existing solutions. Take travel: Cars go 100 kilometers per hour, vs. 10 for the horse-drawn carriages they replaced; commercial airlines go nearly 1000 kph (though not on side streets). Such an order-of-magnitude leap is a prerequisite for long-term success, though it is often not evident right away -- early cars and planes were pretty pokey and expensive.

Few if any of the information-superhighway applications being put forth can be called 10 times better in any serious way. HDTV requires an expensive new tv set and offers only incrementally higher quality than RTV (regular tv). Terabyte digital-video jukebox servers and high-capacity networks for video-on-demand will not lead to a dramatic reduction from the roughly 30 cents an hour per person it costs us to watch a video movie today, or even the $3.50 an hour for the cinema. Such a service will have to offer truly marvelous content that isn't available elsewhere. And 500 channels of the same junk? Forget it. (Of course, we would love to be in an environment that brings out the Fellini in everyone...or maybe just the Spielberg.)

"If people really hated going down the block to pick up a movie, video stores would have a thriving delivery business today."

-- Professor Michael Noll, Annenberg School, USC

There's value in convenience and time savings: witness the success of home-shopping networks and mail-order catalogs. But "painting" a fabric on a

suit template hung on a 3-D mannequin with your physique and face, and then rotating it on-screen seems uninviting, even if technically very sophisticated. Then there's work-at-home, but will it pay for broadband networks? Maybe the benefits will sell in the aggregate...

A use we find compelling is transforming the way people connect with other people. Of course, telephone companies have been connecting people for a hundred years, with great success. Why should people want anything different? Why should they invest in new equipment to get the same experience?

Useful new ways to connect needn't cost a fortune. They involve consolidated address books that make it easier to send messages to groups of people or set up conference calls; uniform message headers that include alternate reply paths, so it's easy to call or fax someone when you get e-mail from them; and transparent network protocols that allow on-screen document sharing across heterogeneous pcs and PDAs (accompanied by a conference call controlled from the same interface, of course). With the 3-D software described above, users can create spectacular rooms in virtual worlds, in which they can interact with others.

We described many such applications in our issues on unified messaging (**Release 1.0**, 12-92 and 1-93) and community (6-93 and 7-93). Few of these applications require video, so they don't need two-way broadband links. With wireless voice and data, ISDN (the Integrated Services Digital Network) or even POTS (plain old telephone service) and a new voice/data modem, a good application developer can work wonders.

How should we optimize the platform?

Traffic patterns often dictate design. Consider that about three-quarters of all phone calls are local. To take advantage of this, a carrier might decentralize its operations, pushing switch-like devices out as far as possible and interconnecting local areas richly. The carrier might offer unlimited local calling and sell enhanced services for monthly fees; the software would be distributed across the switches.

"We're doing this the way you'd plan walkways in a park: Plant grass, then put sidewalks where the paths form."

-- Joe VanLone, CableVision

The opposite approach is Centrex-style services such as central office-based voicemail. Note that LANs and PBXes already offer companies unlimited local connections. Some companies have extended them across geographic boundaries with MANs and virtual private networks. But these concepts haven't made it to the mass market yet. Imagine neighborhoods or virtual communities served with that model.

Now consider that at least a third of all tv viewers at any given time are watching the top three networks. Carriers with switched architectures (the phone companies) have to dedicate expensive equipment to each of those subscribers, rather than broadcast through inexpensive gear. Broadcasters such as the cable tv companies have very cost-effective platforms, but can't handle customization for individual subscribers.

Many cable carriers are moving to a hybrid option: They send both analog and digital signals over the same cable. Time Warner's Full Service project in Orlando will do just that: Network programming will run in low frequencies, much as it does today; 5 to 15 pay-per-view movies will run in mid-range frequencies, still analog; and each household will have a fully customizable, digital "virtual channel" in the highest frequencies. Notably, the system will include wireless voice and data services.

FITL, FTTC and FTTH

Carriers usually contemplate three fiber-deployment strategies: fiber in the loop (FITL), to the curb (FTTC) or to the home (FTTH). Bruce Egan, a research fellow at Columbia University's Institute for Tele-Information and author of **Information Superhighways** (Resources, page 19), has generated estimates of the per-subscriber cost of the three options. According to him, FITL (which roughly corresponds to what cable carriers call Cable Area Networks, described below) runs about $100 per subscriber for either cable tv or telephone suppliers. Much of that is already under way. As the distribution links branch out, costs skyrocket: FTTC costs ten times as much, at $1000 per subscriber. FTTH can range from $1500 to $4000 per subscriber.

By running fiber-optic trunks to selected amplifiers in their networks, cable tv system operators have effectively changed their noisy and unreliable tree-and-branch configurations to a more effective multi-star topology that they call a Cable Area Network. Subscribers get improved signal quality and reliability, without much additional cost to the cable operator. About 25 percent of cable subscribers are now served by fiber-enriched systems.

Cable tv's coax offers the potential of 2 Gbps into the home, with a much simpler system than the phone companies have. Their plant-in-service per subscriber is $380 vs. $1200, respectively. Ironically, phone companies that invest in FITL and even FTTC (with copper) bring no new offerings to customers, though they do pave the way for broadband services. Today's voice quality is just fine.

Interactivity is the rub. Menu selections (for browsing and selecting items or services), chat rooms, checkers and interactive Wheel of Fortune require far less response speed than telephone calls and multi-player arcade games such as Red Baron. One- or two-second latencies are tolerable for card games; they destroy arcade games and conference calls.

Then there's wireless. For PCS, where do you put the transceivers, and how do you hook them up to the rest of the network? Should the cells be large or small? Should they be cells at all? Should your set-top box act as the base unit for a cordless phone, or should the curbside (or pole-mounted) box house the transceiver? Should you use wireless from the curb to the house, but offer traditional wired phones inside? Can voice and data coexist?

The mix of costs, distances, capacities and features has endless permutations. For example, to be the lowest-priced video-on-demand operator as well as an attractive platform for home-shopping services, a company may

select very inexpensive home devices and store all the digitized video at its network control center on a mainframe or several servers -- plus a huge disk farm. The servers are directly connected to information providers' computer centers. Centralizing complex equipment also reduces field-maintenance costs.

To offer a wide variety of interactive games with different price points and upgrade paths, a company might choose multiple communication options. For example:

- For unlimited role-playing, chess and card games, subscribers use their infrared remote controls and a flat-rate, high-latency, local-area service such as Metricom's. They can also play from any portable device equipped with a radio modem.

- For multiplayer vr arcade games, players must buy gloves and helmets and wire them to SGI set-side boxes. The SGI machines are on a narrowband, low-latency link to a central (or regional) server. Graphics are generated locally; network traffic is manageable.

- For a live, multi-party jam session and dance space, participants must add camcorders and get high-bandwidth connections.

Finally, to emphasize mobility and customization, a cellular/PCS carrier may offer voice and data connections and information services that make full use of its network's intelligence. Subscribers first set up a profile. With it, (for a fee), they get messages, stock prices or news stories that might interest them; automatic message management (it's from Zoe, so it's important; it's after 10pm, so I'll send the caller to voicemail); and location-dependent information such as traffic alerts or nearby food and entertainment suggestions.

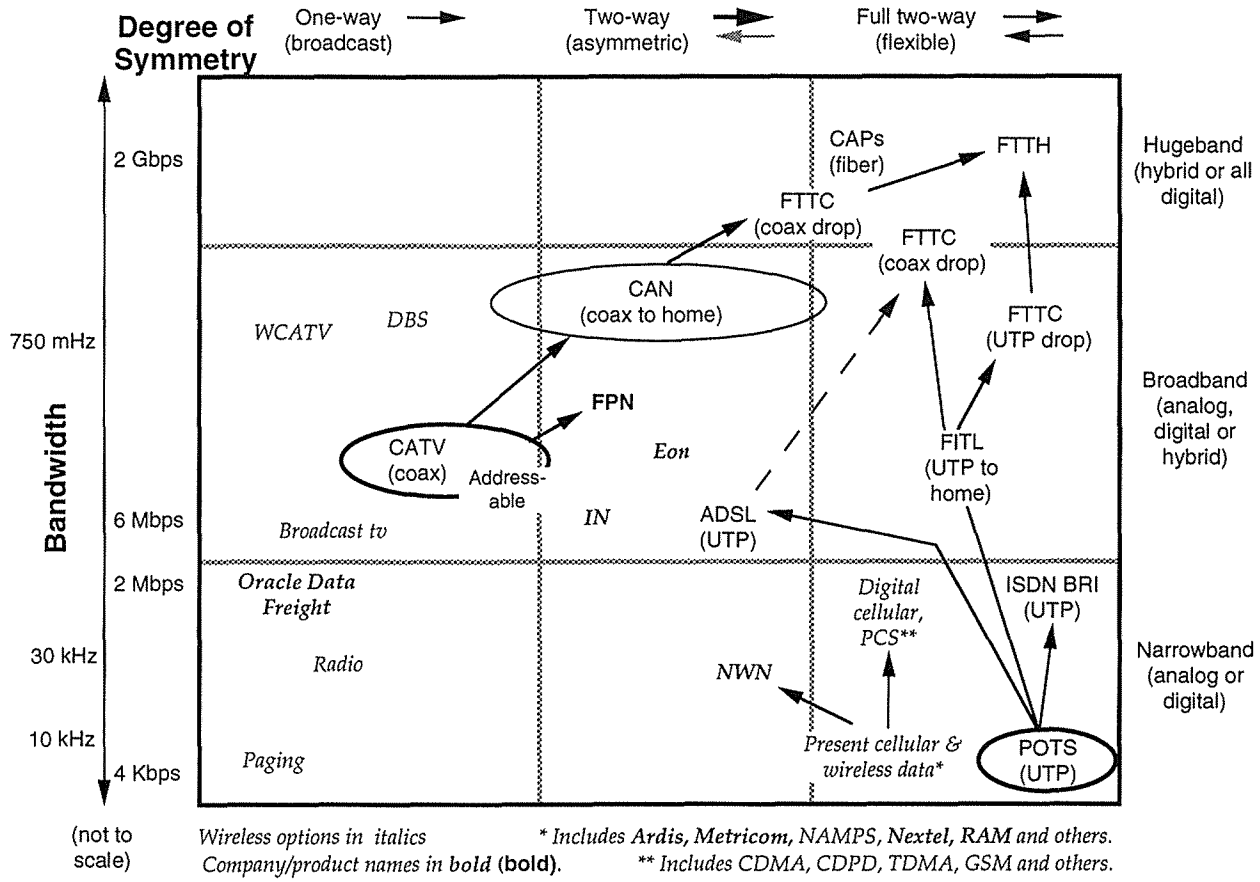
What if the concept of tv "channels" changed altogether -- if you could subscribe to a hosted 'zine that pointed to things all over the place, including conventional channels? Would you implement this in the head-end (or switch), the neighborhood server or the remote control (VCR+ meets Newton)?

How do we get there?

The chart, opposite, illustrates potential technological trajectories for cable tv and phone companies, as well as a few others. None is surefire, though if video is important, the cable companies have a leg up with their installed base of coax to the home. Most players own desirable assets, whether billing systems, media libraries or licensed radio frequencies. Combining them creatively is key.

Phone companies will find upgrading their local loop to coax or fiber very expensive (see below), though some telcos are already convincing their state overseers to approve such expenditures. If they decide to stick with copper, there are other snags. Phone switches are not designed for video time

US Electronic Communications Infrastructure Options



Not all communications require symmetric links. Some products and technologies offer intentionally lopsided capacity, such as First Pacific Networks (FPN), which folds digital two- way voice and data sessions into a larger analog stream of video channels that are headed toward the subscriber.

On the chart, the ellipses labeled CATV and POTS (cable tv and plain old telephone service) are the starting points. Fiber to the home is by no means everyone's goal, though it is often made out as the Holy Grail of telecommunications. Many carriers will find that the services they want to offer work fine over other media. At this time, coax seems to offer the right balance between flexibility, cost and capacity for broadband communications. Wireless carriers will be trying hard to obviate the need for fiber long term.

Most phone and many cable companies have already installed fiber backbones. With CANs and upgraded amplifiers, cable tv carriers can offer two-way service. The size of the upstream channel is quite controversial now, because it will likely be very small to start, limiting interaction.

Acronyms

ADSL	Asymmetric Digital Subscriber Loop
CAN	Cable-Area Network
CAP	Competitive Access Provider
CATV	Cable tv
CDMA	*Code Division Multiple Access*
CDPD	*Cellular Digital Packet Data*
DBS	*Direct Broadcast Satellite*
FITL	Fiber In the Loop
FTTC	Fiber To the Curb
FTTH	Fiber To the Home
FPN	**First Pacific Networks**
GSM	*Groupe Speciale Mobile (Europe)*
IN	***Interactive Networks***
ISDN	Integrated Services Digital Network
NAMPS	*Narrowband Advanced Mobile Phone Svc.*
NWN	***Nationwide Wireless Network***
POTS	Plain Old Telephone Services
RAM	***RAM Mobile Data***
TDMA	*Time Division Multiple Access*
UTP	Unshielded Twisted (copper) Pair
WCATV	*Wireless Cable tv*

sharing. A third of the existing copper plant is unsuitable for ISDN or ADSL: Carriers have to remove load coils and untangle bridges and taps. Even then, equipment and maintenance will be expensive, since moving broadband signals over copper requires heavy processing and careful tuning.

Cable companies now serve over 65 percent of US households with one-way broadband services, and pass in front of most of the rest. About 36 percent of current subscribers have "addressable" units, but that doesn't mean much.[2] Nevertheless, cable franchisees aren't as new to two-way networks as one might think: Many municipal franchise contracts require the catv company to provide so-called institutional networks that link schools, emergency services or local government buildings. Zenith, DEC and other companies sell hardware to these markets.

"The information superhighway will have eight lanes coming to you and a goat path in return."

-- George Gleason, Community Dialtone

To phone, or not to phone

There are plenty of reasons why cable tv companies might want to avoid the local phone business. First, they would likely become common carriers, which means a whole new set of lawyers and restrictions. Cable tv franchises aren't used to offering hookups to all who apply.

Second, they would have to meet new standards of reliability. The phone-system standard is two minutes a year of downtime. Phones don't fail when the power goes out; cable systems would have to provide equivalent service. (How about cordless phones linked to distributed switches with uninterruptible power supplies?)

Third, cable companies would have to assign and administer phone numbers. (In fact, as more companies enter the fray, the numbering plan is likely to undergo more changes similar to those required for 800-number portability, which occurred May 1 of this year.) Suppliers' billing would also get much more complex.

Finally, cable companies will have to play in the phone system's intelligent network. Clearly, these are all things that phone companies do already, which makes phone/cable alliances especially appealing. Folding voice into the video network is an essential feature. Cable companies should do it, even without phone-company help.

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2 *Addressable means only that the head-end can selectively allow individual subscriber units to watch a particular channel, as in pay-per-view. Because almost all of the amplifiers in the cable tv distribution network today are one-way only, subscribers have to call a voice-response system to order a show.*

Speedy rollout

Some technologies make rapid, selective deployment easy. For instance, once a satellite is safely in orbit (not the easy part), everyone under its shadow has access: Potential subscribers need only go to a store to buy a dish and terminal unit. Compare that to the decade it took for cable tv systems to build market penetration. Eager prospects had to wait until their town sold the franchise, the carrier dug the trenches and the field rep installed the cable connections.

But wireless cable and direct broadcast satellite tv (DBS) are one-way only. To offer even minimal interactivity they need a back channel. Companies such as Interactive Networks and Eon (formerly TV Answer) tried to do this, using phone and radio links, with little success.

Wanted: tried and true protocols

Capacity is only half the story; the other half is protocols. In order to roll out services in the next couple of years, carriers need proven protocols, such as ISDN (proven to work, if not to sell), TCP/IP and GSM (Groupe Speciale Mobile, the European digital cellular phone standard). Parts of ISDN may survive the entire standard. For example, the messaging protocol Q.931 is used in other communication systems.

Although ISDN is slowly picking up momentum, it may yet kill itself by neglecting market reality. Coax is clearly going to compete for the traffic, but nobody's working on ISDN over coax. It's clear that people will have to buy new phones for ISDN, or install Terminal Adapters for their old analog phones. But there are few, if any, cordless ISDN phones or ISDN-compatible answering machines available -- and those are the most popular home telecom items.

In order to overcome incompatibility problems, the National ISDN User's Forum (sponsored by the National Institute of Standards and Technologies) has defined a series of uses for ISDN. Each of them includes specifications that vendors agree to follow, thus improving interoperability.

"[Upgrading the phone network to] ADSL is like feeding a horse vitamins rather than buying a truck."

-- Eli Noam, Columbia University

Asymmetric Digital Subscriber Loop is a Bellcore-developed way to feed one-way video over copper twisted pair alongside a voice and data session. Despite high per-household costs (a line card in the central office plus equipment in the home), ADSL could be an efficient service in areas with low market penetration. When community demand is high enough to warrant an upgrade to coax or fiber, phone companies can move the line cards to other neighborhoods. Long term, the switched telephone system is not likely to be an efficient way to broadcast network tv.

CLEVER SOLUTIONS

Of the companies mentioned in this section, only Metricom has an installed base; the rest are great ideas. Metricom started in the utility industry, and offers wireless data networks with Fidonet/Internet-style distributed control and intelligence. Community Dialtone is what the local-exchange carriers could all become, if they listen to their customers. The last two test the nature of the high-speed backbone: CircuitPath offers efficient distribution for high-speed ATM backbone networks; SONeTech heralds the complete deconstruction of the communications infrastructure.

METRICOM

Metricom was founded in 1985 by Paul Baran, the inventor of the packet switch. Since 1988, Metricom has been selling UtiliNet, a radio data-communications system that started as a way for utility companies to read meters remotely. Now it is moving into the mainstream.

Since its first utility installation in 1988, Metricom has grown to 90 employees and can claim 20 sites at a dozen utility clients. The companies use UtiliNet for distribution automation, demand-side management and improved customer service. Utilities like it because it's an efficient way to poll a large number of nodes and collect information quickly. (Although these systems are relatively slow, with 9600-baud data rates and message turnaround times of 10 to 15 seconds, they can collect large numbers of meter readings quickly.) Metricom is beginning to sell into industrial markets, including oil and gas fields, municipal waste-water systems, railroads and airports.

An all-you-can-eat local loop

More interestingly, Metricom is launching its own wireless network, starting in the San Francisco bay area. Since Metricom's nodes pass messages to each other within a metropolitan area (see box, next page), they don't require a connection to an interexchange carrier or X.25 network. That's different from almost all other wireless systems, where every radio node is connected to public or private long-haul networks. It also brings costs down.

The company expects to have its own network up in 30 cities by the end of 1995. Each network will cover roughly 300- to 400-square-miles; Metricom will bridge the regional nets with fiber connections, for which it will charge extra.

Apple was an early alpha site for Metricom's network; Stanford University and Visa are betas. Metricom's own network is faster than its UtiliNet product, with a raw data rate of 76 Kbps that offers users 50 to 60 Kbps peak transfer rates and latencies under two seconds. It can't handle arcade games, but is tremendously useful for e-mail and such applications, and is considerably faster than competitors such as Ardis and RAM, which offer well under 10 Kbps effective throughput.

Metricom's customers will pay fixed monthly fees for set data rates, with no limit on traffic within a local connection area. Unlimited 2400-baud transmission costs $3 a month; 56-Kbps service costs $20. In fact, because of its decentralized architecture, Metricom can't offer per-transaction bill-

ing. This kind of distributed, self-diagnosing, all-you-can-eat networking should thrive in the upcoming information environment. It is the kind of infrastructure that is needed for the sessionless online services we described in **Release 1.0**, 6-93 ("No more logins, no more waiting").

Chumming the airwaves

Unfortunately, sales happen slowly in the utility industry, and Metricom has yet to make money; it lost $4.5 million in 1992. It expects sales to the utility and industrial markets to break even in 1994, and will need to invest in its own network for several years more. Initially funded by New Enterprise Associates and Arete, Metricom went public this year; Paul Allen also invested a very visible $17.5 million.

Things are looking up: There's a feeding frenzy in wireless communications, and Bob Dilworth, Metricom's president, has positioned his company to benefit. Dilworth has been in the computer and communication industry since 1966, including roles at Varian and Sperry/Univac and as president of Morrow Designs. Most recently he was president of Zenith Data Systems, which he left in 1987 for Metricom, with the rights to some Zenith technology for packet-radio modems in the ISM (industrial, scientific and medical) bands.

A (bit) bucket brigade

Metricom nodes have precise geographic addresses (latitude and longitude coordinates) and are aware of each other; that makes it easy for them to forward packets toward their destination, the way a bucket brigade gets water to a fire. If the packets don't go through because a node is down or busy, the nodes automatically seek a different path. Nodes that detect problems automatically report and work around them.

The company uses frequencies that don't require licensing as long as the transmitter stays at low power. Each transmitter hops between all of the 160 possible channels (using frequency-hopping, spread-spectrum radio techniques). Units piggyback for more capacity. In essence, Metricom's system is a giant, connectionless, half-duplex network.

The transmitters Metricom makes itself in Los Gatos cost only $700 and can be hung from lampposts, train trestles or cowsheds, practically eliminating real-estate hassles. They are waterproof, shielded against lightning and (optionally) protected with uninterruptible power supplies. Local connections can be over power lines or standard serial ports. To outside devices, Metricom's network can look like an AT modem or a TCP/IP node.

The company also has portable radio units running at beta sites. These modems are slightly smaller than Ericsson's Mobidem or Motorola's InfoTAC, though those companies have much smaller devices working now.

COMMUNITY DIALTONE

George Gleason is about to take on the Baby Bells -- or at least one of them. With his startup called Switching and Networks, he intends to offer richly enhanced telephone service to Berkeley businesses and communities now under Pac Bell's jurisdiction. His Community Dialtone's advantage is customization: keeping close to his users, so he can tune his system to their needs. He is driven by a deep desire to make the communications system work for its customers, by which he means the entire community, including those too poor to pay.

What can Gleason do that Pac Bell has ignored? He has a slew of interesting features in store. Tired of your kid running up the long-distance bill every month? Get him an allowance on Gleason's phone system. Billy has to enter his initials to make a call (you get a PIN that we hope you can keep secret). Once he burns through his allowance, he has to stop. Customers with no credit can get prepaid accounts. Homeless people can have free voicemail accounts so they can be reached.

Want ISDN now? Gleason can offer it. Digital cordless local-area phones? No problem. Ericsson, his vendor of choice, offers a model with enough range to find you at your neighbor's house. Would you like distinctive ringing, where each member of a household or business has a different extension -- and sound? Guess what.

Community Dialtone could also support telecommuters and virtual companies, with four-digit dialing across households and multiple businesses. Gleason could promise speedy service, as well as easy data connections and gateways (and maybe free community-access e-mail accounts), multiparty conference calls (beyond the usual limit of three), cheap calling cards, and local untimed telephone service. In fact, Community Dialtone could return some of the simplicity that used to characterize the phone system. No more worrying about separate decisions for handsets, long-distance company and inside wiring maintenance. Local operators, local repair staff.

Listening to this list makes you realize how little we have been allowed to exploit the telephone infrastructure. If Pac Bell were to offer such services, Gleason would be delighted.

Community Dialtone is a spinoff from the Integrated Signal group, Berkeley's oldest independent telecom contractor. Its public-service branch, People's Telecom, serves non-profit and public interest groups. Right now Gleason is a telecom contractor for several Berkeley businesses totaling roughly 1000 subscribers and is bidding on others. His pricing is about even with Pac Bell's, but he's offering more services.

He expects to open his first public exchange this year. He has lined up several clients, and is looking for financing. Gleason has plenty of work ahead to make Community Dialtone a reality, especially getting authority to be a local-access provider, if Pac Bell gets testy. Market and regulatory trends are in Gleason's favor, but he may well need a partner that is interested in reshaping the local-exchange rules in California.

CIRCUITPATH

What do you do when you've decided you want to use ATM, but think it's too expensive to deliver to everyone's desk? You can wait until more products hit the market and prices drop, which could take quite a while. Or you could turn to Ray Sanders, who founded CircuitPath Network Systems to develop a cost-effective solution. His technology, called Synchronous Adaptive Transfer Mode (SATM), bridges that gap. Sanders expects to offer less expensive gear that uses the communication networks more effectively while fitting gracefully into existing and future architectures. SATM is designed as an efficient distributor of high-speed bandwidth into corporate and home networks, carrying any kind of voice, video and data traffic.

The SATM Distributed Switch that CircuitPath is developing focuses on connecting one voice/video/data terminal with one or more other terminals. It provides bandwidth on demand for the emerging multimedia market. Major applications for SATM are as distribution networks for broadband ATM backbone networks. With third-party hardware and software, SATM devices could replace intelligent hubs, PBXes, multiplexers, gateways and switches. (In a sense, it could be a distributed switching unit in SONeTech's system, below.) Unlike ATM, SATM supports very low speeds as well as higher ones; it uses channels at near capacity with low control overhead. It can set up or re-allocate channels in milliseconds (see box).

More on ATM and SATM

Bellcore chose ATM as one of two modes for SONET, the Synchronous Optical Network that operates at speeds up to 2.4 Gbps (the other is Synchronous Transfer Mode). ATM is efficient with traffic that runs at over 45 Mbps, not with the slow stuff we'll be running for some time to come, such as 9600-baud modems. If the low-speed links are not aggregated and multiplexed onto the ATM system (requiring another device), they use the ATM network inefficiently.

Despite its name, Asynchronous Transfer Mode is synchronous: Nodes have to work in lockstep to exchange information. What's asynchronous about ATM is that senders have no idea which time slot their information will occupy; the system works at such high speeds that it doesn't matter. That's how ATM supports time-sensitive media such as live voice and video (isochronous communications). ATM requires complex flow control and bandwidth allocation. It works on each cell, changing the header before sending it to the desired outbound port.

In contrast, SATM switches at the bit level. Its value comes in setting up and tearing down virtual circuits extremely quickly. If the incoming stream can't go out, it is halted, not buffered.

Imagine high-speed digital communication as a chewing-gum factory. ATM fills each pack with 48 sticks and labels it (room for another 5 sticks) before sending it to a carton for shipping. Interim handlers inspect the label, change the address, then forward the packs. SATM sends sticks out in bits (not bytes), first telling the handlers which bits go to which destination. This lets SATM provide precisely variable bandwidth up to 50 Mbps to desktop users.

An SATM Service Node is friendly to both sides of the communications network: to the outside network, it looks like an ATM node; to devices on the inside networks -- and there can be many, of different flavors -- it looks like a high-speed gateway to the rest of the world. Between the inside and outside worlds, SATM's efficient architecture makes sure that communication links are loaded.

Ray Sanders has been in the communications business for a long time. An early X.25 promoter, he founded Tran Telecommunications in 1969. Tran built large-scale digital communications networks, most notably in Canada, California and overseas. Amdahl bought Tran in 1980, and Sanders stayed for two years, helping Amdahl understand how to sell the Tran services. Then Sanders helped launch Nucleus, which developed new architectures for very large databases used by phone companies, among others. After seven years at Nucleus, he spent two years as chairman of CJComm, a video communications company, and founded CircuitPath in April 1992.

Sanders is targeting cable companies, forward-thinking local-exchange carriers and system integrators. Early applications might include campus networks and inter-carrier connections. He expects to have initial products on the market by 1995; now he's looking for investors.

SONETECH

Fred Seigneur wants to deconstruct the phone system. His logic is simple and compelling:

- The systems that now run our telecommunications infrastructure are just like the mainframes of the computer world, and will suffer the same fate. Customers are fed up with waiting for features from their carriers, who in turn have to wait for their switch suppliers to include them. Competition is being stifled.

- As local- and wide-area networks increase in speed and open up to user control, the difference between the bus inside a digital switch and the network itself fades.

- By defining modular elements of the intelligent network, Bellcore and its partners have also defined the components needed to distribute the network's functions into the local loop -- and beyond their control.

- Someone could use these standards and off-the-shelf elements to move the software off the monolithic switches and distribute it across the network, which would create opportunities for third-parties to write great software.

This would also allow competitive access providers to become integral parts of the intelligent network. Seigneur says his early discussions indicate that they find the concept very attractive. In fact, a CAP could put service modules on its network and sell Centrex services, or put the modules on the customer's premises, where they could play the role of a PBX or data hub. Of course, there are millions of lines of code in the so-called gener-

ics that run today's digital switches -- potential opportunities for companies such as Microsoft and Novell. So Seigneur wants to work within larger partnerships of the sort he experienced before at Martin-Marietta.

Two plus two equals six

SONeTech is adapting elements of the phone system's architecture to its own purposes: SONET transmission technology offers LAN-like backbone speed, which SONeTech reinterprets as a bus for connecting distributed switching units. Fiber In The Loop specifies broadband communication architectures between central offices. And the Integrated Digital Loop Carrier (IDLC), effectively a dumb switch, defines copper distribution from that point to subscriber premises.

Dumb switches are completely externally programmable. Modest enhancements can turn an IDLC device into a hardened, fault-tolerant and SONET-compatible dumb switch that can be attached to any medium -- fiber, coax or copper. You could then call it a Distributed Switching Unit, as Seigneur does in his Open Architecture Distributed Switching Model. To top this model off, Bellcore has defined a software architecture for distributing all sorts of network processors that do the work of the intelligent network.

Seigneur's vehicle is a company named SONeTech (Services-oriented Open Network Technologies) that operates from his home in Sterling, Virginia. He is not alone in his beliefs. Analysts at Probe Research, whose analyses helped cause the divestiture of AT&T and have already predicted the destruction of the local telephone-company monopolies, are strong backers. SONeTech will be a think tank, and write licensable "glue" software for open, distributed switching systems.

How he got here

From 1968 to 1976, Seigneur worked for the Air Force, building transmission, voice switching and data communications systems. There he launched an early software-development group that created experimental distributed minicomputer time-share networks. Later he worked on distributed database systems and protocol conversion, among other things, and was involved in early work on TCP and IP. After the Air Force, Seigneur kept developing software for the military, including network management systems for the Defense Communications Agency's operations in Europe.

"We want to do for the Superhighway what Unix did for the Internet."

-- Fred Seigneur, SONeTech

In 1982 Seigneur went to Martin-Marietta, where in 1985 he worked alongside the regional Bell operating companies and MCI on a bid for the huge FTS-2000 government telecom contract. They lost the contract, but Seigneur liked their solution and saw the power of their work relationships. He has used that model in planning SONeTeam, a wholly owned subsidiary of SONeTech in-

tended as an incubator and integration lab for participants. Several companies have indicated their interest in participating.

Seigneur left Martin-Marietta in 1990 to become director of software development at Pulsecom, a telecom equipment vendor. There he was a principal architect of a SONET-based Integrated Digital Loop Carrier system. In October 1992, he left and started consulting with Probe Research while formulating plans for SONeTech, which he founded in 1993.

Seigneur is working on a business plan, and is at least two years from field trials, with product deliveries a year after that -- if he's lucky. But the concept is powerful. SONeTech could allow entrepreneurs such as George Gleason to participate much more broadly in the communication infrastructure. Competitive access providers that now offer only transmission capacity could become integral elements of the intelligent network. Software developers could write applications for the distributed switching platforms that normally would have been written only by the switch manufacturers. The creativity of the pc-software industry would be turned loose on the entire telecom world, not just the desktop server.

COMING SOON

- *New! Improved! Multimedia!*
- *Logistics as a business.*
- *Software for education.*
- *Constraint-based reasoning.*
- *Pen stuff.*
- *And much more... (If you know of any good examples of the categories listed above, please let us know.)*

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For further reading:

Egan, Bruce L.; **Information Superhighways: The Economics of Advanced Public Communication Networks**, Artech House, 1991, Norwood MA.
Seigneur, Fred; "Get Ready for a Network Revolution", Telephony Magazine, October 11 1993, page 34.
US Senate Bill 1086, "Telecommunications Infrastructure Act of 1993", Senators Daniel Inouye and John Danforth; anonymous ftp to ftp.eff.org; file is /pub/eff/legislation/infra-act-s1086
Electronic Frontier Foundation, Open Platform Campaign: Public Policy for the Information Age; EFF, (202) 347-5400; anonymous ftp to ftp.eff.org; file is /pub/eff/papers/op2.0
MFS Communications, petition for notice of Inquiry into Policies and Programs to Assure Universal Telephone Service in a Competitive Market Environment; International Transcript Service, (202) 857-3800

RELEASE 1.0 CALENDAR

December 5-9 **Lotusphere '93** - Orlando. Sponsor: Lotus Development. Call Diane Horak, (617) 862-4515.

December 6-8 **Wireless Datacomm '93** - Washington, DC. Sponsor: Business Communications Review. Call Linda Hanson, (914) 779-8711.

December 6-9 **SGML '93** - Boston. Sponsor: Graphic Communications Association. Call Marion Elledge, (703) 519-8160; fax, (703) 548-2867.

December 6-9 **Internet World/Document Delivery World '93** - New York City. Sponsored by Internet World Magazine and Document Delivery World Magazine. Call Nancy Melin, (203) 226-6967; fax, (203) 454-5840.

December 7-9 **@Consumer Information Appliance conference** - New York City. Sponsored by Jupiter Communications and Arlen Communications. Call Harry Larson, (212) 941-9252; fax, (212) 941-7376.

1994

January 10-13 **Object World** - Boston. Sponsored by IDG World Expo. Call Rachel Winett, (508) 879-6700; fax, (508) 872-8237.

January 23-26 ***Demo '94** - Palm Springs. Stewart's picks. Sponsored by InfoWorld Editorial Products. Call Tracy McGee, (415) 312-0545.

February 2-4 ***Executive technology summit '94** - Tampa. Sponsor: Computerworld. Call Paul Gillen, (508) 620-7724; fax, (508) 875-8931.

February 6-12 **Software Development** - Santa Clara. Sponsor: Miller Freeman. Call Koann Vikoren, (415) 905-2265; fax, (415) 905-2222.

February 15-17 **Networks Expo (formerly NetWorld)** - Boston. Sponsored by Bruno Blenheim. Call Annie Scully, (201) 346-1400 or (800) 829-3976; fax, (201) 346-1532.

February 21-24 **GIS '94: Symposium on geographic information systems** - Vancouver. Sponsored by Polaris Conferences. Call Penny Sopel, (604) 688-0188; fax, (604) 688-1573.

February 21-25 **Documentation '94** - Los Angeles. Sponsored by GCA. Call Marion Elledge, (703) 519-8160; fax, (703) 548-2867.

Feb 28-Mar 3 ***GroupWare '94** - Boston. Sponsored by The Conference Group. Call David Coleman, (415) 282-9151; fax, (415) 550-8556.

March 2-4 **Converging technologies conference** - St. Petersburg. Sponsored by the Poynter Institute for Media Studies. Call Jennette Smith, (813) 821-9494; fax, (813) 821-0583.

March 13-16 **SPA spring symposium** - San Francisco. Sponsored by the Software Publishers Association. Call Karen Johnson, (202) 452-1600; fax, (202) 223-8756.

March 16-23 **CeBIT '94** - Hannover, Germany. Sponsor: Hannover Fairs. Call Mette Fisker Petersen, (609) 987-1202; fax, (609) 987-0092.

March 20-23 ****EDventure Holdings PC Forum** - Phoenix. Sponsored by us: You read the newsletter; now meet the players. Call Daphne Kis, (212) 924-8800; fax, (212) 924-0240; MCI 511-3763.

March 21-23 **AAAI spring symposium** - San Francisco. Sponsor: American Association for Artificial Intelligence. Call Annette Eldredge, (415) 328-3123; fax, (415) 321-4457.

March 22-25	**Seybold Seminars '94** - Boston. Sponsor: Seybold Seminars. Call Beth Sadler or Kevin Howard, (310) 457-5850 or (800) 433-5200; fax, (310) 457-8599.
March 23-25	**UniForum '94** - San Francisco. Sponsor: World Expo. Call Bill Leitch, (508) 879-6700.
March 23-26	***Fourth Computers, Freedom and Privacy conference** - Chicago. Sponsored by ACM and The John Marshall Law School. Call George Trubow, (312) 987-1419; fax, (312) 427-8307.
April 12-14	**New Media Expo** - Los Angeles. Sponsored by The Interface Group. Call Peter Shaw, (617) 449-6600.
April 18-20	**ATRE** - Kyoto. Sponsored by Dasar. Call Alex Vieux, (415) 321-5544; fax, (415) 321-5597.
April 18-21	**@EMA '94** - Anaheim. Sponsor: Electronic Mail Association. Call Heather Burneson, (703) 524-5550; fax, (703) 524-5558.
April 19-21	**Networks Expo** - San Francisco. Sponsor: Bruno Blenheim. Call Annie Scully, (201) 346-1400; fax, (201) 346-1602.
April 26-29	**Vision '97** - Scottsdale. Vendor interaction symposium. Sponsored by Xplor International. Call Anne Davison, (310) 373-3633; fax, (310) 375-4240.
April 28-May 1	**ITAA spring management conference** - San Francisco. Sponsor: Information Technology Association of America. Call Valerie Entner, (703) 522-5055; fax, (703) 525-2279.
May 4-6	**Digital World** - Los Angeles. Sponsor: Seybold Seminars. Ca;; Beth Sadler or Kevin Howard, (310) 457-5850 or (800) 433-5200; fax, (310) 457-8599.
May 16-19	**European electronic document systems conference & exhibit** - Nice, France. Sponsored by Xplor International. Call Anne Davison, (310) 373-3633; fax, (310) 375-4240.
June 5-8	***SPA Europe's annual conference** - Cannes. Sponsor: Software Publishers Association Europe. Call Ken Wasch, (202) 452-1600; fax, (202) 223-8756; Viviane Lemonnier, 33 (1) 4692-2703; fax, 33 (1) 4692-2531.
June 9-11	**The Grace Hopper celebration of women in computing** - Washington, DC. Co-sponsored by the Computing Research Association and the ACM. Call Anita Borg, (415) 617-3335.
June 19-22	**1994 Burton Group conference on network computing** - Colorado Springs. Sponsor: The Burton Group. Call Julie Wightman, (801) 943-1966; fax, (801) 943-2425.
June 20-24	**Software DevCon** - Wiesbaden, Germany. Sponsor: SIGS Conferences. Call Jurgen Tillack, 49 (22) 02302886; fax, 49 (22) 023-2997; James Spencer, (212) 274-0640; fax, (212) 274-0646.
July 31-Aug 4	**Artificial Intelligence conference** - Seattle. Sponsor: AAAI. Call Annette Eldredge, (415) 328-3123; fax, (415) 321-4457.
August 8-12	**GroupWare '94** - San Jose. Sponsored by the Conference Group. Call David Coleman, (415) 282-9151; fax, (415) 550-8556.
September 8-10	***ETRE** - Barcelona. Euro-Glitterati. Sponsored by Dasar. Call Alex Vieux, (415) 321-5544; fax, (415) 321-5597.

Please let us know about events we should include. -- Denise DuBois

**Events Esther plans to attend.*
@Events Jerry plans to attend.
Lack of a symbol is no indication of lack of merit.

Platforms for Communication Forum 1994
Interactivity is two-way!

We invite you to attend the Seventeenth Annual PC Forum, to be held this year in Phoenix, Arizona, from March 20 to 23. Each Release 1.0 subscription (plus the fee!) entitles you to two registrations for the Forum.

Each year, the Forum raises issues that will play out in the year ahead. Last year, our theme was "content is key" -- a theme echoed throughout 1993 as media giants and telecom and computer companies tried to converge with alliances, technology transfers, people moves and other methods.

We have changed PC Forum's full first name from Platforms for Computing to Platforms for Communication -- reflecting computers' changing role in the real world. The focus is no longer person and computer, but people communicating through computers.

This year, our theme is "Interactivity is two-way!" That is, don't forget the people at the other end of the wire, fiber, or radio link. The "content" of interactivity isn't e-mail or videos or even multimedia; it's communication and connection with other people. It's *attention* and *feedback* from colleagues and friends, customers and suppliers. In both business and consumer markets, successful vendors will design and offer services where interactivity means more than the ability to select from one of 500 channels or even one of several story scenarios...

In business, employees need to work and learn individually, but they also need to work together and interact as a "learning" organization. Beyond the desktop, there's a group and a whole organization...

In the consumer sphere, people want to create as well as receive messages and multimedia productions. They want to express themselves and create their own environments for fun and interaction with others. Suppliers can add value, but customers want a role in the process too; vendors have to provide easy-to-use tools to let users/consumers participate.

Our goal at the Forum is to examine -- interactively with you -- the new virtual landscape of the computer industry, from both technical and business perspectives. After all, why do you need to come to this conference? Why not just read a newsletter, buy a newspaper, read a book, watch a video?

The reason is clear: You need more than just canned information. You need to interact with your peers, to try out your ideas against someone else's experience, to learn by arguing. You need to share private and public moments with others...including the Monday-night jam session.

Some of the specific topics we'll address in general sessions -- and in the corridors, bars, social events and sports facilities nearby -- include the design of online video-conferencing salons, the role of traditional entertainment companies in the new world of "convergence," and the impact of government agencies and policies.

More broadly, how can technology foster learning in organizations and the convergence of electronic democracy and markets: Do we really want to let people vote directly on everything? Or is there a way to have some informed discussion first? (Quick, what do you think -- yes or no?) What will be the impact of ubiquitous connectivity: Are you constantly connected (good)? Or tightly tethered and unfree (bad)? What levels of data security and freedom of expression are appropriate in which environments? What's the trade-off between privacy and an "open society"?

On a more technical level, we'll discuss and demonstrate some of the tools and services involved: OS platforms, consumer multimedia tools, interactive customer support, wireless communications, groupware, conferencing systems and applications.

To tackle these topics, we are assembling an impressive roster.

Speakers will include:

Alan Ashton	WordPerfect
John Seely Brown	Xerox
Steve Case	America Online
Bob Epstein	Sybase
John Gage	Sun Microsystems
Joe Guglielmi	Taligent
Stacy Horn	ECHO
Bob Kavner	AT&T
Scott Kurnit	Prodigy
Ed McCracken	Silicon Graphics
Jim Manzi	Lotus
Mike Maples	Microsoft
Marc Porat	General Magic
Bruce Sterling	Himself

Company presentations and demos will include:

Collabra
CompuServe
Metricom
nett info

and several others to be announced!

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